CLAIMS

We claim:

1. A method for simulating structural responses of a compressible material in finite element analysis, the method comprising:

calculating a plurality of stress function values f(λ), wherein each of the plurality of stress function values equals to summation of a sequence of $\lambda^{[-\upsilon]^j}\ \sigma_0\left(\lambda^{[-\upsilon]^j}\right)$, where **j** is an integer related to j-th term of the sequence, λ is a particular stretch ratio of interest, ν is Poisson's ratio of the compressible material, and $\sigma_0\left(\lambda^{[-\upsilon]^j}\right)$ is the stress value at $\lambda^{(-\upsilon)^j}$ defined by stress-strain curve for the compressible material;

storing the plurality of stress function values into a lookup table; and

evaluating element stresses in local coordinate system using the stress function values from the lookup table via interpolation based on a set of principal stretches at each integration point of each finite element of the compressible material at each solution cycle.

2. The method as recited in claim 1, wherein the sequence has a total of **m** terms, and **m** is a positive integer, and the term of the sequence starts from 0 to m-1.

3. The method as recited in claim 1, wherein the element stresses include nominal stress and true stress.

4. The method as recited in claim 1, wherein the set of principal stretches is obtained by solving eigensolution for deformation gradient tensor of the finite element.

5. The method as recited in claim 1, further comprising:

transforming the element stresses to global coordinate system.

6. The method as recited in claim 1, wherein the finite element analysis is based on explicit finite element analysis solution method.

7. The method as recited in claim 1, wherein the finite element analysis is based on implicit finite element analysis solution method.

8. The method as recited in claim 1, wherein the stress-strain curve for the compressible material is obtained from a uniaxial loading test.

9. The method as recited in claim 1, wherein the calculating step completes when absolute value of $|\lambda^{(-\upsilon)^j} - 1|$ is less than a threshold.

10. The method as recited in claim 9, wherein the threshold is defined as 0.01.

11. A finite element analysis software product to be executable in a computing device for simulating structural responses of a compressible material in finite element analysis, the software product comprising:

program code for calculating a plurality of stress function values $f(\lambda)$, wherein each of the plurality of stress function values equals to summation of a sequence of $\lambda^{[-\upsilon]^j}\,\sigma_0\left(\lambda^{[-\upsilon]^j}\right)$, where **j** is an integer related to j-th term of the sequence, λ is a particular stretch ratio of interest, ν is Poisson's ratio of the compressible material, and $\sigma_0\left(\lambda^{[-\upsilon]^j}\right)$ is the stress value at $\lambda^{(-\upsilon)^j}$ defined by stress-strain curve for the compressible material;

program code for storing the plurality of stress function values into a lookup table; and

program code for evaluating element stresses in local coordinate system using the stress function values from the lookup table via interpolation based on a set of principal stretches at each integration point of each finite element of the compressible material at each solution cycle.

12. The software product as recited in claim 11, wherein the sequence has a total of **m** terms, and **m** is a positive integer, and the term of the sequence starts from 0 to m-1.

13. The software product as recited in claim 11, wherein the element stresses include nominal stress and true stress.

14. The software product as recited in claim 11, wherein the set of principal stretches is obtained by solving eigensolution for deformation gradient tensor of the finite element.

15. The software product as recited in claim 11, further comprising:

program code for transforming the element stresses to global coordinate system.

16. The software product as recited in claim 11, wherein the finite element analysis is based on explicit finite element analysis solution method.

17. The software product as recited in claim 11, wherein the finite element analysis is based on implicit finite element analysis solution method.

18. The software product as recited in claim 11, wherein the stress-strain curve for the compressible material is obtained from a uniaxial loading test.

19. The software product as recited in claim 11, wherein the calculating step completes when absolute value of $|\lambda^{(-\upsilon)^j} - 1|$ is less than a threshold.

20. The software product as recited in claim 19, wherein the threshold is defined as 0.01.